B.7.6 Residues Resulting from Supervised Trials (Annex IIA 6.3; Annex IIIA 8.3)

B.7.6.1 Residues in Target Crops

B.7.6.1.6 Papaya

Document ID:	MRID No. 49455906 Report:Dorschner, K. (2013) Abamectin: Magnitude of the Residue on Papaya. Project Number: 04078. Unpublished study prepared by Interregional Research Project No. 4. 143 p.
Guidelines:	EPA OCSPP Harmonized Test Guideline 860.1500 Crop Field Trials (August 1996) PMRA Regulatory Directive DIR98-02 – Residue Chemistry Guidelines. Section 9 – Crop Field Trials PMRA Regulatory Directive DIR2010-05 – Revisions to the Residue Chemistry Crop Field Trial Requirements OECD Guideline 509 Crop Field Trial (September 2009)
GLP Compliance:	No deviations from regulatory requirements were reported which would have an impact on the validity of the study.
Acceptability:	The study is considered scientifically acceptable. The acceptability of this study for regulatory purposes is addressed in the forthcoming U.S. EPA Residue Chemistry Summary Document, DP# 424008.
Evaluator:	Nancy Dodd Nancy Dodd

Note: This Data Evaluation Record (DER) was originally prepared under contract by Versar, Inc. (6850 Versar Center, Springfield, VA 22151; submitted 2/27/15). The DER has been reviewed by HED and revised to reflect current Office of Pesticide Programs (OPP) policies.

EXECUTIVE SUMMARY

The Interregional Research Project Number 4 (IR-4) has submitted field trial data for abamectin on papaya. Three field trials were conducted in the United States during the 1998 growing season in the North American Free Trade Agreement (NAFTA) Growing Zone 3 (FL).

Each trial consisted of one untreated plot and one treated plot. At each trial location, the treated plot received three foliar broadcast applications of a 0.15 lb ai/gal emulsifiable concentrate (EC) formulation of abamectin (Agrimek 0.15 EC) at 0.0246-0.0272 lb ai/A/application for a total seasonal rate of 0.0738-0.0816 lb ai/A. Applications were made at retreatment intervals (RTIs) of 13-15 days using ground equipment in spray volumes of ~151-201 gal/A. A horticultural oil spray adjuvant was used. Papayas were harvested at a preharvest interval (PHI) of 3-5 days.

All samples were maintained frozen at the testing facilities, during shipping, and were stored frozen at the analytical laboratory until analysis. The maximum storage interval for samples between harvest and extraction was 337 days (11.1 months). Samples were analyzed within 3 days of extraction. Acceptable storage stability data are available demonstrating that residues of avermectin B_{1a}, avermectin B_{1b}, and 8,9-Z avermectin B_{1a} are stable under frozen storage for at

least 24 months in five different crop types: high water (celery, pear, and tomato), high acid (orange, lemon, grapefruit, and strawberry), high protein (bean), high fat (sunflower seed), and high starch (potato) (DP# 191433, 5/19/94, G.J. Herndon; and DP# 414022, 5/15/14, N. Dodd). These data are adequate to support the storage conditions and durations of samples from the submitted field trials.

Papaya samples were analyzed for residues of avermectin B_{1a}, avermectin B_{1b}, 8,9-Z avermectin B_{1a}, and 8,9-Z avermectin B_{1b} using a high performance liquid chromatography (HPLC) method with fluorescence detection adapted from Merck Method No. M-073. The method determines residues of avermectin B_{1a} + 8,9-Z avermectin B_{1a} as a single analyte and residues of avermectin B_{1b} + 8,9-Z avermectin B_{1b} as a single analyte. Acceptable method validation and concurrent recoveries were reported for samples fortified with avermectin B_{1a} and 8,9-Z avermectin B_{1a} at 0.002-0.3 ppm and with avermectin B_{1b} at 0.002 ppm, thus validating the method. The limit of quantitation (LOQ; determined as the lowest level of method validation, LLMV) was 0.002 ppm for each analyte; the combined LOQ was 0.004 ppm. The fortification levels used in method validation and concurrent method recovery were adequate to bracket expected residue levels (within an order of magnitude). Concurrent recoveries and residues in treated samples were not corrected for apparent residues in controls.

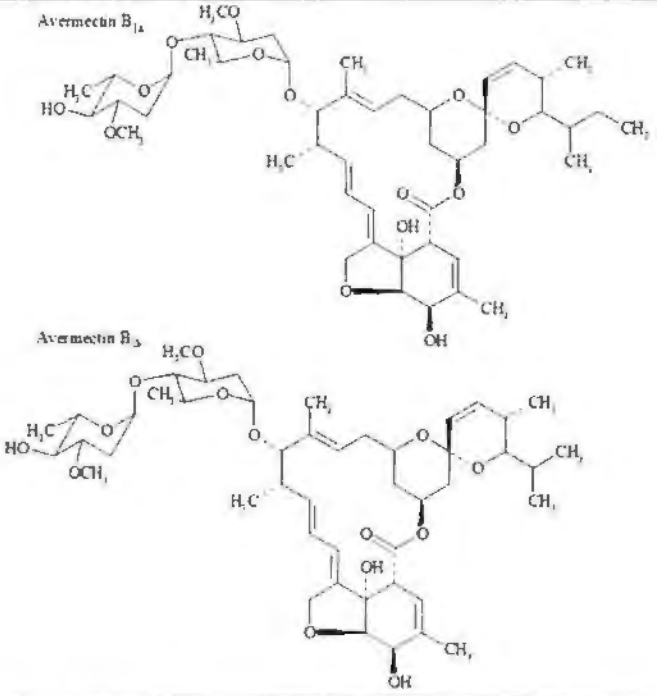
In papaya harvested 3-5 days following the last of three foliar broadcast applications of a 0.15 lb ai/gal EC formulation of abamectin at a total application rate of 0.074-0.082 lb ai/A, residues (and per-trial averages) of abamectin (determined as the sum of avermectin B_{1a}/8,9-Z avermectin B_{1a} and avermectin B_{1b}/8,9-Z avermectin B_{1b}) were <0.0047-0.164 ppm (<0.0051-0.131 ppm). Residue decline was not evaluated.

I. MATERIALS AND METHODS

A. MATERIALS

Table B.7.6.1.6-1. Nomenclature for Abamectin.	
Common name	Abamectin: Abamectin B_1
Identity	mixture of ≥80% (10*E*,14*E*,16*E*)-(1*R*,4*S*,5′*S*,6*S*,6′*R*,8*R*,12*S*,13*S*,20*R*,21*R*,24*S*)-6′-[(*S*)-*sec*-butyl]-21,24-dihydroxy-5′,11,13,22-tetramethyl-2-oxo-(3,7,19-trioxatetracyclo[15.6.1.1^{4,8}.0^{20,24}]pentacosa-10,14,16,22-tetraene)-6-spiro-2′-(5′,6′-dihydro-2′*H*-pyran)-12-yl 2,6-dideoxy-4-*O*-(2,6-dideoxy-3-*O*-methyl-α-L-*arabino*-hexopyranosyl)-3-*O*-methyl-α-L-*arabino*-hexopyranoside and ≤20% (10*E*,14*E*,16*E*)-(1*R*,4*S*,5′*S*,6*S*,6′*R*,8*R*,12*S*,13*S*,20*R*,21*R*,24*S*)-21,24-dihydroxy-6′-isopropyl-5′,11,13,22-tetramethyl-2-oxo-(3,7,19-trioxatetracyclo[15.6.1.1^{4,8}.0^{20,24}]pentacosa-10,14,16,22-tetraene)-6-spiro-2′-(5′,6′-dihydro-2′*H*-pyran)-12-yl 2,6-dideoxy-4-*O*-(2,6-dideoxy-3-*O*-methyl-α-L-*arabino*-hexopyranosyl)-3-*O*-methyl-α-L-*arabino*-hexopyranoside
CAS no.	71751-41-2
Company experimental name	MK0936
Other synonyms (if applicable)	Not applicable

Table B.7.6.1.6-1. Nomenclature for Abamectin.



B. Study Design

1. Test Procedure

Three residue trials were conducted on papaya during the 1998 growing season reflecting three foliar broadcast applications with a 0.15 lb ai/gal EC formulation of abamectin at 0.074-0.082 lb ai/A. Field trial locations by NAFTA growing zone are summarized in Table B.7.6.1.5-2.

The trials separated by <20 miles have been assessed for independence as detailed in the table below. Because the geographic area suitable for papaya cultivation in the U.S. is limited, HED has concluded that these trials may be considered separate trials for purposes of OCSPP 860.1500 data requirements.

Independent Trial Determination[1]		
Trial Nos.	Differences	Decision
FL15, FL17, FL63	Variety: FL15 and FL63 Known You #1, FL17 Red Lady Offset: FL17 >30 days Spray volume: FL17 volume >25% higher than FL15 and FL63. *No other differences in criteria for FL 15 and FL63	FL17: Separate due to variety, off-set, and spray volume. FL15 and FL63: Separate due to limited cultivation in the U.S.

[1] All assessments are based on the replicate trial guidance presented in draft memo 568_Criteria for Independence of Trials, 04/23/2013 (EPA and PMRA).

Table B.7.6.1.6-2. Trial Numbers and Geographical Locations.

Crop	No. Trials	NAFTA Growing Zone													Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	
Papaya	Sub.			3											3
	Req.[1]														3 or 2

[1] As per Table 1 of OCSPP 860.1500 for papaya, three trials with a minimum of 6 samples or two trials with a minimum of 8 samples are required. Geographic distribution is not specified for crops requiring ≤3 trials. Per Table 6 of OCSPP 860.1500, Zone 13 accounts for 96% of U.S. papaya production.

Locations and detailed use patterns for the trials are provided in Table B.7.6.1.5-3.

Table B.7.6.1.6-3. Study Use Pattern.

Location, City, State; Year (Trial ID)	End-use Product[1]	Method of Application; Timing of Application	Volume (gal/A)	Rate per Application (lb ai/A)	Retreatment Interval (days)	Total Rate (lb ai/A)	Surfactant Adjuvant[2]
Goulds, FL; 1998 (98-FL15)	0.15 lb ai/gal EC	1. Foliar broadcast; fruit present	151.19	0.0246	--	0.0738	Horticultural oil
		2. Foliar broadcast; mature green fruit on tree	151.19	0.0246	15		
		3. Foliar broadcast; mature green fruit	151.19	0.0246	14		
Homestead, FL; 1998 (98-FL17)	0.15 lb ai/gal EC	2. Foliar broadcast, mature and immature fruit present	201.27	0.0272	--	0.0816	Horticultural oil
		2. Foliar broadcast; mature and immature fruit present	201.27	0.0272	15		
		3. Foliar broadcast; mature fruit present	201.27	0.0272	13		
Homestead, FL; 1998 (98-FL63)	0.15 lb ai/gal EC	1. Foliar broadcast; mature and green fruit present	151.19	0.0246	--	0.0738	Horticultural oil
		2. Foliar broadcast; mature green fruit present	151.19	0.0246	15		
		3. Foliar broadcast, mature green fruit	151.19	0.0246	14		

[1] A 0.15 lb ai/gal emulsifiable concentrate (EC) formulation of abamectin (Agrimek 0.15 EC) was used.
[2] Brand name: Sun-Spray Ultra-Fine Year-Round Pesticidal Oil

Papayas were grown and maintained according to typical agricultural practices. Irrigation was used to supplement rainfall at all sites. No unusual weather conditions were reported to have adversely affected crop growth or yields during the study.

Sample Handling and Preparation

Duplicate control and treated samples of papaya were harvested 3-5 days after the last application. All samples were placed in frozen storage at the field sites within 2 hours of harvest and were shipped frozen within 6-12 days of harvest by Agricultural Chemicals Development Services, Inc. (ACDS) freezer truck to the analytical laboratory, ABC Laboratories (Columbia, MO). At the analytical laboratory, samples were stored frozen (~-20 °C) prior to preparation and analysis. The samples were prepared for analysis by homogenizing in the presence of dry ice.

2. Description of Analytical Procedures

Samples were analyzed using an HPLC method with fluorescence detection adapted from Merck Method No. M-073, entitled "HPLC-Fluorescence Method for the Quantitation of Avermectin B_1 and 8,9-Z Avermectin B_1 in/on Fruits and Vegetables: Commodity – Stone Fruit." A complete description of the method, including details of minor method modifications was included in the submission.

Briefly, samples were extracted with acetonitrile (ACN):0.1% phosphoric acid (25:75, v:v) and then partitioned with hexane three times. The hexane phases were combined, dried with anhydrous sodium sulfate, and purified on an aminopropyl solid phase extraction (SPE) column. Residues were eluted with ethyl acetate:methanol (75:25, v:v). The eluate was evaporated to dryness under nitrogen and redissolved in ACN, then subjected to derivatization with trifluoroacetic anhydride. The derivatized residues were analyzed by HPLC with fluorescence detection. Because each avermectin and 8,9-Z isomer pair yields a common product after derivatization, the method determines residues of avermectin B_{1a} + 8,9-Z avermectin B_{1a} as a single analyte and residues of avermectin B_{1b} + 8,9-Z avermectin B_{1b} as a single analyte.

The LOQ (determined as the LLMV) was 0.002 ppm for each analyte; the combined LOQ was 0.004 ppm. The petitioner also presented calculated values for the limit of detection (LOD) and LOQ based on the recoveries obtained at the 0.002 ppm fortification level. The LOD was calculated by multiplying the standard deviation of recovery measurements at the LLMV by the one-tailed t-statistic (confidence level not reported) for three or four replicates, and the LOQ was defined as 3x the LOD. The calculated LODs and LOQs were, respectively: 0.0006 and 0.0018 ppm for avermectin B_{1a}, 0.0006 and 0.0019 ppm for 8,9-Z avermectin B_{1a}, and 0.001 and 0.0033 ppm for avermectin B_{1b}.

II. RESULTS AND DISCUSSION

Method performance was evaluated during method validation and by use of concurrent recovery samples. For method validation, samples of untreated papaya were fortified with avermectin B_{1a} and 8,9-Z avermectin B_{1a} at 0.002-0.3 ppm and with avermectin B_{1b} at 0.002 ppm. For concurrent recoveries, samples were fortified with avermectin B_{1a} at 0.002-0.1 ppm. Recoveries were within the acceptable range of 70-120%; therefore, the method was considered valid for the analysis of abamectin residues in papaya matrices. The fortification levels bracketed the measured residues (within an order of magnitude). Concurrent recoveries were not corrected for apparent residues in controls.

No data were provided concerning the linearity of the detector response. Representative chromatograms of control samples, fortified samples, and treated samples were provided. The control chromatograms generally had no peaks of interest above the chromatographic background. The fortified sample chromatograms contained only the analyte of interest, and peaks were symmetrical and well defined. Residues in controls were ≤0.002 ppm. The reported residue values were not corrected for apparent residues in controls.

Table B.7.6.1.6-4. Summary of Method Validation and Procedural/Concurrent Recoveries of Abamectin from Papaya.					
Matrix	Analyte	Fortification Level (ppm)	Sample size (n)	Recoveries[1] (%)	Mean ± Std. Dev. (%)
Method Validation					
Papaya	Avermectin B_{1a}	0.002-0.3	12	85.5-105	95.9 ± 6.72
	8,9-Z Avermectin B_{1a}	0.002-0.3	12	74.6-99.8	85.2 ± 7.35
	Avermectin B_{1b}	0.002	3	86.3-101	95.4 ± 7.97
Concurrent Recoveries					
Papaya	Avermectin B_{1a}	0.002-0.1	3	78.1-103	89.0-12.7

[1] Concurrent recoveries were not corrected for apparent residues in controls.

Samples were stored frozen for a maximum of 337 days (11.1 months) from harvest to extraction (Table B.7.6.1.5-5). Samples were analyzed within 3 days of extraction. Acceptable storage stability data are available demonstrating that residues of avermectin B_{1a}, avermectin B_{1b}, and 8,9-Z avermectin B_{1a} are stable under frozen storage for at least 24 months in five different crop types: high water (celery, pear, and tomato), high acid (orange, lemon, grapefruit, and strawberry), high protein (bean), high fat (sunflower seed), and high starch (potato) (DP# 191433, 5/19/94, G.J. Herndon; and DP# 414022, 5/15/14, N. Dodd). These data are adequate to support the storage conditions and durations of samples from the submitted field trials.

Table B.7.6.1.6-5. Summary of Storage Conditions.				
Matrix	Analyte	Storage Temperature (°C)	Actual Storage Duration[1]	Interval of Demonstrated Storage Stability
Papaya	Avermectin B_{1a}	~-20	98-337 days (3.2-11.1 months)	Residues of avermectin B_{1a}, avermectin B_{1b}, and 8,9-Z avermectin B_{1a} are stable under frozen storage for at least 24 months in five different crop types: high water (celery, pear, and tomato), high acid (orange, lemon, grapefruit, and strawberry), high protein (bean), high fat (sunflower seed), and high starch (potato) (DP# 191433, 5/19/94, G.J. Herndon; and DP# 414022, 5/15/14, N. Dodd).
	8,9-Z Avermectin B_{1a}			
	Avermectin B_{1b}			

[1] Interval from harvest to extraction. Samples were analyzed within 1-3 days of extraction.

The results from the submitted field trials are presented in Tables B.7.6.1.5-6 and B.7.6.1.5-7. In papaya harvested 3-5 days following the last of three foliar broadcast applications of a 0.15 lb ai/gal EC formulation of abamectin at a total application rate of 0.074-0.082 lb ai/A, residues (and per-trial averages) of abamectin (determined as the sum of avermectin B_{1a}/8,9-Z avermectin B_{1a} and avermectin B_{1b}/8,9-Z avermectin B_{1b}) were <0.0047-0.164 ppm (<0.0051-0.131 ppm). Residue decline was not evaluated.

Table B.7.6.1.6-6. Residue Data from Papaya Field Trials with Abamectin.[1]								
Location: City, State; Year (Trial ID)	Zone	Papaya Variety	Matrix	Total Rate (lb ai/A)	PHI (days)	Abamectin Residues[2] (ppm) [Average]		
						Avermectin B_{1a} + 8,9-Z B_{1a}[3]	Avermectin B_{1b} + 8,9-Z B_{1b}[3]	Combined Residues[4]
Goulds, FL; 1998 (98-FL15)	3	Known You #1	Fruit	0.0738	3	0.0905, 0.149[5] [0.120]	0.00806, 0.0147[5] [0.0114]	0.0986, 0.164 [0.131]
Homestead, FL; 1998 (98-FL17)	3	Red Lady	Fruit	0.0816	5	0.00266, 0.00352 [0.0031]	ND, ND [<0.002]	<0.0047, <0.0055 [<0.0051]
Homestead, FL; 1998 (98-FL63)	3	Known You #1	Fruit	0.0738	3	0.0937, 0.131 [0.112]	0.00857, 0.0122 [0.0104]	0.102, 0.143 [0.123]

[1] A 0.15 lb ai/gal emulsifiable concentrate (EC) formulation of abamectin (Agrimek 0.15 EC) was used.
[2] The LOQ was 0.002 ppm for each analyte, and the calculated LODs were 0.0006 ppm for avermectin $B1_a$ and 8,9-Z avermectin $B1_a$ and 0.001 for avermectin B_{1b}. Combined residues and per trial averages were calculated by the study reviewer using the LOQ for residues reported as <LOQ.
[3] The method determines residues of avermectin $B1_a$ + 8,9-Z avermectin $B1_a$ as a single analyte and residues of avermectin B_{1b} + 8,9-Z avermectin B_{1b} as a single analyte
[4] Combined residues of avermectin B_{1a} + 8,9-Z avermectin B_{1a}, and avermectin B_{1b} + 8,9-Z avermectin B_{1b}.
[5] Mean of duplicate analyses.

Table B.7.6.1.6-7. Summary of Residues from Papaya Field Trials with Abamectin.										
Crop Matrix	Total Application Rate (lb ai/A)	PHI (days)	n[1]	Abamectin Residues[2] (ppm)						
				Min.[3]	Max.[3]	LAFT[4]	HAFT[4]	Median[4]	Mean[4]	SD[4]
Papaya	0.074-0.082	3-5	3	<0.0047	0.164	<0.0051	0.131	0.123	0.0863	0.0705

[1] n = no. of field trials.
[2] Combined residues of avermectin B_{1a}/8,9-Z avermectin B_{1a}, and avermectin B_{1b}/8,9-Z avermectin B_{1b}.
[3] Values based on total number of samples
[4] Values based on per-trial averages. LAFT = lowest average field trial, HAFT = highest average field trial, SD = standard deviation. For computation of the LAFT, HAFT, median, mean, and standard deviation, values < LOQ are assumed to be at the LOQ (0.004 ppm).

III. CONCLUSIONS

The papaya field trials are considered scientifically acceptable. In papaya harvested 3-5 days following the last of three foliar broadcast applications of a 0.15 lb ai/gal EC formulation of abamectin at a total application rate of 0.074-0.082 lb ai/A, residues (and per-trial averages) of abamectin (determined as the sum of avermectin B_{1a}/8,9-Z avermectin B_{1a} and avermectin B_{1b}/8,9-Z avermectin B_{1b}) were <0.0047-0.164 ppm (<0.0051-0.131 ppm). Residue decline was not evaluated.

An acceptable method was used for residue quantitation, and adequate storage stability data are available to support sample storage durations and conditions for all analytes.

IV. REFERENCES

DP# 191433, 5/19/94, G.J. Herndon
DP# 414022, 5/15/14, N. Dodd